NOTES ON SOME RATS DAMAGING CROPS IN SOUTH INDIA.

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It is universally recognized that there are few animal pests that cause, by their depredations, greater loss to man than those belonging to the group popularly known as Rats. On account of their numerical strength, wide distribution, their great fecundity and adaptability to varying conditions and omnivorous feeding habits, these have attained unenviable notoriety all over the world. But it is only recently, comparatively speaking, that the highly important rolê played by them in the destruction of crops has come into prominence. The destruction caused to crops by these is undoubtedly frightful, the loss sometimes amounting to very nearly fifty per cent of the gross outturn.

Incredible as it may seem, it is nevertheless a fact that Economic Zoologists, particularly in India, have paid deplorably little attention to this group of rodents; consequently there is practically very little on record regarding the exact species concerned in the damage, their habits and the method of their control, except the very brief and passing reference made by Fletcher in his excellent book on *Some South Indian Insects*. Therefore, the present paper, so far as the writer is aware, is perhaps one of the first if not the first venture in this direction in South India.

Although a variety of important crops such as Paddy, Ragi and other grain crops, Sugarcane, Cotton, Coconuts, Tea, etc., are subject to the ravages of these pests, it is a pity that our knowledge of these is very scanty and limited and it is no wonder that any control measures based on such knowledge as we possess of the lifehistory and habits of field rats have been in most cases unavailing. It is believed, therefore, that any information regarding the biology of these animals, mode of life, occurrence, breeding, habitations, etc., will be of great importance in tackling this serious problem. With this view the writer has been devoting some time and thought for the last few years, amidst his other duties, to the study of this particular group. To this end some of the most important species, e.g. the Southern Mole-rat *Gunomys,* were kept under observation in cages at the Insectary and elsewhere. The habitations of many have been examined in the fields and some repressive measures also have been carried out though to a limited extent.

In any branch of study the correct identification of the species should form a necessary preliminary and should always precede other aspects of study. The proper identification of this class of

rodents has been a matter of some difficulty as a result of the vast strides of progress in our knowledge in this line since the publication by Dr. Blanford of his classical work on Mammalia in the *Fauna of British India* series. Since 1891 when this standard work on Mammalia was published so many new forms have been discovered, and so many changes in nomenclature have been found necessary that identifications based mainly on this work will necessarily be to a certain extent out of date. The progress in this direction is mainly due to the Mammal Survey conducted by the Bombay Natural History Society the results of which are published in the various volumes of the *Journal*. Therefore with the help of the latter the nomenclature of each species has been carefully investigated and the writer has thought it wise to include along with the distinguishing characters of each species, the present day nomenclature, chief synonyms, the popular and vernacular names and a few facts about their distribution. Vernacular names are given wherever known but these will be of little value as the ryots do not discriminate between the various kinds of rats but often apply one common name for all.

The idea of the paper is primarily to introduce the reader to such of the species of rats as have come within the personal cognizance of the author in South India, as also to indicate the gaps in our knowledge and the lines on which further investigations are needed. Some explanatory notes regarding the details of habits of some species with a few remarks about the nature and extent of damage to various crops and their status, with a brief reference to the localities wherefrom they have been collected are added under each species. A few remarks regarding their control partly based on the writer's experience have also been included so as to impart a sort of completeness to the subject dealt with. In presenting these few notes nobody is more conscious than the writer that the work is necessarily very defective and incomplete in regard to every aspect of study, and the only justification for the preparation of this paper is that it may at least serve to invite the attention of economic biologists to the importance of this group of animals.

The material on which the paper is based consists of specimens collected by various persons from time to time and received by the Government Entomologist, Coimbatore, as well as those collected by the writer as opportunities offered. Hence the writer is under great obligations to the Government Entomologist for the opportunities afforded, especially at the beginning of the study, and to those members of his staff who have helped with specimens. The writer is also indebted to the Bombay Natural History Society for having confirmed and corrected his provisional determinations of the different species of rats.

In the matter of arrangement of the different species the writer has gone a little out of the way because the main consideration has been the order or degree of destructiveness of the species concerned. So far as the writer's observation goes the premier place according to this criterion will have to be assigned to the Southern Mole-Rat (*Gunomys*.) Then next in order come the Soft-furred Field Rat, the South Indian Gerbil, etc., which are also responsible for a good deal of damage to crops.

FAMILY : MURIDÆ.

Sub-family : GERBILLINÆ.

Genus : TATERA, Lat.

Tatera, Lataste 1882. Wroughton. *J.B.N.H.S.,* xxv. p. 40, 1917 and xxvi, p. 779, 1919.

The group of animals represented by the name *Gerbilus indicus* in Blanford's Mammalia No. 264 was separated as the sub-genus under the name *Tatera* in 1882 and later on Indian forms were named *Tatera* as a full genus in 1902. The tail of these forms is dark above and below and pale along the sides. *Tatera* has the sole and foot entirely naked whereas *Gerbilus* has sole and foot hairy.

(1) **Tatera cuvieri** Waterhouse. **The South Indian Gerbil.**

1838. *Gerbilus cuvieri* Waterhouse, *P.Z.S.,* p. 56.

1891. *Gerbilus indicus* Blanford, Mammalia, No. 264 (Part).

1917. *Tatera cuvieri* Waterhouse Wroughton, *J.B.N.H.S.,* xxv, p. 44.

Vernacular name.—*Velleli* (white rat).

These buffy coloured rats have their feet longer and their tails are also nearly two inches longer than typical *indica* and this is the distinguishing character of *cuvieri.*

Head and body 5·2 in—7·2 in about 6·6 in.

Tail more than 7·9 in (*indica* less than 7·5 in).

Hind foot 1·4 in—1·9 in about 1·7 in.

This is not an uncommon species. It is not so universally distributed as *Gunomys.* This species is destructive to paddy, especially stored paddy, outside buildings in Aduturai (Tanjore). They also destroy coconut seedlings in some parts of Malabar by burrowing underneath and feeding on the tender portion of the shoot inside. Our knowledge about the habits of this animal is unsatisfactory. These have more or less a straight run and the depth might vary from ½ to 2 feet. The burrows may have more than one entrance. These burrows are often made in a day and are not so extensive as those of *Gunomys.* The rats perhaps have their permanent residence in adjoining bushes, prickly-pear and such suitable places. These are also reported to store a good lot of grain in their burrows.

Sub-family : MURINÆ.

Genus : GUNOMYS, Th.

Gunomys, Thomas. *Ann. & Mag. Nat. Hist.,* xx, p. 202, 1907 and *J.B.N.H.S.,* xviii, p. 465, 1908.

From the genus *Mus* (Rats) the bandicoots were first separated by Gray in 1842 under the generic name *Nesokia* (*Nesocia* of Blanford). Thomas seeing three well-marked groups in this genus divided *Nesokia* into three genera (*Ann. Mag. Nat. Hist.,* xx, p. 202, 1907). Blanford uses *Nesocia* (as he spelt it)—*Nesokia* for all the groups. But Thomas restricted the name to include only the short tailed

mole-rat of Northern India and at the same time revived the genus *Bandicota* and erected the genus *Gunomys* to represent the Southern or long-tailed mole-rats. The chief characters of *Gunomys* are the small size, and length of the tail being more than two-thirds of head and body, and, mammae being irregular, 14-18 in number. Whereas *Nesokia* has the tail very short less than two-thirds of head and body; mammae 2-2=8; *Bandicota*—Size large, tail almost as long as head and body; mammae 3-3=12.

(2) **Gunomys kok** Gray. **The Southern Mole-rat.**

1837. *Mus kok* Gray. Charl. *Mag. N.H.I.*, p. 585.

1891. *Nesocia bengalensis* Blanford, Mammalia, No. 295. (Part).

1908. *Gunomys kok* Wroughton, *J.B.N.H.S.*, xviii, p. 747.

Vernacular names.—*Kurumbai yeli; Erumira yeli* (i.e. noise like coughing of man) also called Paddy field rat.

Distinguishing Characters.—Length of upper molar series 8 mm. Head and body, 6-9″, Tail 5-7″. Fur, fine soft. General colour dark greyish brown. Belly, greyish white. Tail, practically bare.

This is perhaps the most formidable of our crop destroyers. It is a very abundant species throughout the Madras Presidency extending even to the hills. They are very destructive to paddy everywhere. They are known to damage paddy in such widely different places as Coimbatore, Samalkota, Tanjore (Aduturai) and many other places. They also destroy Ragi crops in Coimbatore to a very large extent. Many other crops, such as roots of Tea bushes in Anamalais Estate, have also received their attentions. They are concerned in the destruction of coconut seedlings in some parts of Malabar by burrowing underneath the soil and feeding on the tender portion of the seedlings. They also destroy Tapioca roots in Malabar and sometimes feed on the underground portions of plantains and Colocasia in the same district. In the Southern taluks of Malabar it has been noted to be a bad pest of a variety of pumpkin—*Cucurbita maxima*—whose large fruits, resting on the ground, are eaten into from under the soil leaving only the hard outer rind intact and to all appearance undamaged. Mole-Rats are very destructive to Lucerne crops in the Central Farm, Coimbatore, by eating away the soft succulent portion of the roots. In these plots regular rows of these plants can be seen dried up. If pulled out they are found to be devoid of the root portion which has been devoured by rats.

It may, therefore, be assumed that this is the most destructive species in South India, attacking as it does a variety of crops, being plentiful in and near about cultivated fields. Its favourite resorts are paddy fields. In Coimbatore they are equally abundant in Ragi fields. Several of their habitations in both paddy and ragi fields have been dug out and several specimens collected and examined and the following account of their habits and habitat is mainly based on such observations.

In paddy fields the burrows are chiefly confined to the bunds when the crop is in ears. But during the off season burrows are not found in all bunds but are restricted to those bunds situated by the side of water channels; probably the species requires to be near water being a good diver and probably a great drinker. The runs are long,

extensive and somewhat complicated. They may extend to 20 or 30 feet or even more. They have sometimes four or five openings or exits. The runs seldom go beyond a depth of 2 feet below ground and are rarely more than 3 or 4 inches in diameter. The presence of a burrow is always indicated by the heap of fresh earth thrown by the side of the bund. Generally the main entrance is kept obscured from view by this heap of earth. There are sometimes three or four branchings (even half a dozen) some of which may end in blind ways. It is because of these exits that the rat often escapes from some unexpected side of the bund when digging is going on at the other side several feet away. Generally only one rat, rarely two, is found to inhabit one burrow. In the breeding season it is easy to find a mother with a number of young ones rising up to ten. The nest in the breeding chamber consists of grasses and other leaves. Inside such runs plenty of grain (paddy earheads) are hoarded up in the harvesting season. At other times small accumulations of grasses and roots can be seen, showing that they can subsist on these for a time. Sometimes remains of crabs such as the carapace, limbs, etc., have been recovered, along with grasses, from the runs.

In the Ragi fields the conditions are slightly different and the burrows are seldom found on bunds but are practically within the fields themselves. The branching runs in Ragi fields are confined within a radius of 4 or 5 feet and lead into a kind of central chamber. The destruction done to the crop is considerable. From one of the burrows, extending nearly to a depth of 2 feet with three side exits, dug out recently, which had only one female occupant, a quantity of Ragi earheads which would give nearly three-quarters of a Madras measure of grain, was actually recovered and there are numerous such habitations in the field.

These rats are very active and wonderfully agile and are gifted with considerable speed as is evident from their alertness in escaping. They also dive splendidly in water in fields, so much so that four men could not recapture one that escaped in water. They are very fierce and utter a peculiar grunting sound when in fear or anger. Mole-Rats are to a certain extent pugnacious among themselves as is shown by the fact that when two adult specimens were kept in captivity in a cage they carried on some kind of fight and the male lost almost the whole of its tail which was bitten off by the female. After three days the same poor creature was severely injured by its companion and actually killed. A mother and nine young ones, captured from paddy fields, were kept in cages under observation for nearly eight or nine months. These were confined in woden cages the sides of which were much gnawed into and such portions had to be covered with tin plates. In confinement the rat is very fierce and often jumps and dashes against the glass sides and wire gauze in attempting to bite anything that comes near. These were mainly fed on Cholam earheads, cotton seeds from bolls, paddy, pomegranate fruits, Ragi earheads, prickly-pear fruits, wheat, gingelly seeds, etc., but they will eat anything that is supplied, with great avidity. The young ones in three months became adults and one of these produced nine young ones at a birth. The mother made a nest

with cotton lint thrown into the cage within which the young ones were wrapped. When this cotton padding was disturbed the mother was observed to carefully set it right by rearranging them in cotton.

They were born naked and blind and did not open their eyes until after some days, nearly one month, when they were covered with fur and fairly grown. They were completely helpless till about that time. One peculiar case of cannibalism was observed in this instance, within fifteen days of producing young ones, seven out of nine were eaten up by the mother, one after another.

The chief enemy of these rats is probably man. Mole-Rats are eagerly searched for by some communities in South India and captured for food. In Tanjore the Pariahs are said to dig up the bunds and feed on the flesh of these animals which is said to be good eating.

The control of this rat is rather difficult. Fumigation will not be effective as the runs are extensive and poison baiting is no use as the rats may not eat this when there is plenty of other food available. The best thing under the circumstances especially in paddy fields will be to employ professional rat catchers to dig up the bunds in the off season and carry on a regular campaign against them.

Genus : MILLARDIA, Th.

Millardia Thomas, *J.B.N.H.S.*, xx, p. 998, 1911.

The Genus *Millardia* was erected by Thomas in 1911 for the 'Meltad' rats and he separated them from *Epimys* as they differed in an essential character, viz. the suppression total or partial of the posterior sole pads.

(3) **Millardia meltada** Gray. **The Soft-furred Field Rat.**

1837. *Golunda meltada* Gray. Charl. *Mag. N.H.I.*, p. 568.
1891. *Mus meltada* Blanford, Mammalia, No. 290.
1911. *Millardia meltada* Thomas, *J.B.N.H.S.*, xx, p. 998.

Vernacular name.—*Pilleli* (Grass Rat).

This is a smaller rat than *Gunomys*. It is dark brownish grey above and pale grey below. The fur is very soft. Head and body about 5 inches, tail 4 inches.

This species does some damage to paddy though it comes only second in rank to *Gunomys*. Specimens of these have been obtained from Adyturai where they are injurious to paddy. The burrows are fewer and shallower and are found in bunds of paddy fields. These will not get into water and have no peculiar habit of diving.

At Coimbatore these rats are confined to cotton fields. They do considerable injury to cotton and sometimes are very numerous. They seem to be gregarious in that more than one (sometimes three or four) may be found in a single burrow where accumulations of cotton kapas, sometimes to the extent of one or two pounds, may be seen. They do not so much inhabit burrows as the cracks of sun baked earth in the fields. They probably have their permanent residence within the adjoining prickly-pear bushes, periodically invading cotton fields nearby.

Genus : Leggada, Gray.

Leggada Gray. Thomas, *J.B.N.H.S.*, xxvi, p. 418, 1919.

The genus *Leggada* was first separated from *Mus* by Gray in 1837 because of the presence of an additional lunate lobe on the anterior face of the first molar. But this character was later on found to be not constant or imperfectly developed. Mr. Thomas, therefore, considered that the name *Leggada* will have to be sunk as a synonym of the genus *Mus*. But he (Thomas) again revived and re-established the name *Leggada* for Field Mice or Jungle Mice and restricted the name *Mus* to House Mice proper the chief difference between the two being longer or shorter muzzle. (*J.B.N.H.S.*, xxvi, p. 418, 1919.)

(4) **Leggada booduga** Gray. **The Southern Field Mouse.**

1837. *Leggada booduga* Gray. Charl. *Mag. N.H.I.*, p. 586.

1839. *Mus lepidus*. Elliot, *Mad. Mag. L.&S.X.*, p. 216.

1891. *Mus booduga* Blanford, Mammalia, No. 287.

1919. *Leggada booduga* Gray. Thomas, *J.B.N.H.S.*, xxvi, pp. 419 and 960.

Vernacular name.—*Chundeli* (Small Rat).

This is a pretty little mouse of varying shades of colour, generally of a greyish white colour. This is easily marked off unmistakably from other rat pests mentioned because of its small size, which varies from $2\frac{1}{2}$ to 3 inches; with a tail about the same length.

This species is somewhat rare. They have been collected from Ragi fields and cotton fields of Coimbatore and they do slight damage to the crops. In the Ragi fields they are found in small burrows in bunds and not in the field itself. The burrows are usually small and simple and not extensive or complicated. They may also be found in heaps of stones near the field. It is said that they display to a great degree the phenomenon of cannibalism inasmuch as many are killed and eaten, if a large number is kept confined in the same cage, even when plenty of food is available.

Genus : Rattus, Linn.

Rattus rattus Linnæus.

The separation of rats under the name *Epimys* from the mice (*Mus*) was proposed by Trouessart in 1881. (*Bull. Soc. Sci. d. Angers*). Hollister showed that the oldest name for the genus is *Rattus* and must be used in place of *Epimys*. The Common Indian House rat *Epimys rufescens* or *Epimys rufescens* 'var. with white under parts' of the Mammal Survey reports and *Mus rattus* of Blanford are indistinguishable from *Rattus rattus* Linnæus, as pointed out by Hollister and confirmed by Hinton, *J.B.N.H.S.*, xxvi, p. 59, 1918. So Blanford's genus *Mus* includes both *Rattus* (rats) and *Mus* (mice) and his *Mus rattus* is *Rattus rattus*. This species *Rattus rattus* shows a definite variation so that many races have been recognized as noted by Hinton (*J.B.N.H.S.*, xxvi, p. 63).

(5) **Rattus rattus wroughtoni,** Hinton. **The Common Indian Rat.**

1891. *Mus rattus* Blanford, Mammalia, No. 272. (part).
1912. *Epimys rufescens,* variety with white under parts Wroughton. *J.B.N.H.S.,* xxi, p. 1189.
1919. *Rattus rattus wroughtoni,* Hinton, *J.B.N.H.S.,* xxvi. p. 384.

Vernacular names.—*Veetteli* (House Rat); *Yeli* (Rat).

This sub-species *R.r. wroughtoni* is recognized by its pure white belly from the other sub-species *R.r. rufescens* which has a dark belly. The general dorsal colour is reddish or yellowish brown. The feet are light whitish or yellowish. This rat is mainly destructive to tender coconuts. Its damage has been noted from Coimbatore and its suburbs, Malabar, Cochin, etc. Perhaps this damage occurs everywhere in the south, its attentions being mainly confined to tender coconuts which are damaged in large numbers. They bite holes through the husk or fibrous portions and through the tender shell of unripe nuts in order to drink the sweet liquid contained within and these spoilt nuts drop down in large numbers. They live and breed inside nests specially constructed in the crown of palms and rarely descend. The nests are made of fibrous strands that serve the purpose of attachment of the leaf stalk to the stem and leaflets. These are wound round after being bitten to the proper size leaving a cylindrical space in the middle.

Some protection may be given to these trees by providing zinc hoods in case the trees are not so close together as to have their leaves touching one another. But in the case of large topes having thousands of trees in contiguous rows the only practicable remedy is to apply poison baits.

(6) **Rattus rattus rufescens** Gray. **The Common House-Rat.**

1837. *Mus rufescens* Gray, *Ann.Mag. N.H.I.,* p. 577.
1891. *Mus rattus* Blanford, Mammalia, No. 272.
1912. *Epimys rufescens* Wroughton, *J.B.H.N.S.,* xxi, p. 405. 405.
1919. *Rattus rattus rufescens,* Hinton, *J.B.N.H.S.,* xxvi, p. 403.

Vernacular names.—*Veetteli* (House-Rat); *Yeli* (Rat).

This is the ordinary house rat and this species is dark bellied (as distinguished from previous sub-species which is white bellied). It is brownish grey in colour (rufous). There is no sharp line of demarcation along flanks.

This rat is omnivorous feeding on all kinds of vegetable and animal food available. Its habits are well known. It lives in roofs of houses and burrows in the ground and store rooms doing considerable damage to stored paddy, cotton seeds and various other stored products. Its havoc is great in warehouses and storehouses as silks, leather goods, carpets and groceries are all subject to its attacks. Besides causing the destruction of property they are also a source of menace to our health being the common carrier of the Plague flea. The justification for the inclusion of this species among crop destroyers is due to the fact that they are very destructive to paddy stored outside soon after harvest—Poison baiting is the only practical remedy.

FAMILY : GLIRIDAE.

(7) **Platacanthomys lasiurus** Blyth. **The Malabar Spiny Mouse.**

1891. *Platacanthomys lasiurus* Blanford, Mammalia, No. 263.

1913. *Platacanthomys lasiurus* Ryley, *J.B.N.H.S.*, xxii, p. 507.

This is the only one of the species mentioned in this paper which has not been seen by the writer. They are reported to live in hollowed out cavities in trees. They are said to destroy pepper, jack-fruit, and cardamoms in hill tracts in Travancore, Anamalais, etc. They are also reported to hoard up grain and roots like Gunomys and Tatera. They are said occasionally to get into toddy pots. They are said to be easily smoked out of the hollow dead branches which form their chief abode.

CONTROL MEASURES.

It has been seen that enormous damage is caused by different species of rats to a variety of crops and the resultant losses in some cases may run to a high percentage. Therefore the consideration of the question of the preventive and control measures of rat damage is of utmost importance. Various methods such as hunting, trapping, fumigation and poison-baiting have been recommended for trial among which the last two—poison-baiting and fumigation—have been given a fair trial in South India with varying results. In any successful application of remedial measures a preliminary knowledge of the habits and mode of life of the pest concerned cannot be over-emphasized. The methods attempted in this part of the Presidency have been carried out on the lines suggested in *Pusa Bulletin* No. 135 of 1922 and these may be briefly summarized as follows.

Poisoning.—This is the quickest means of destroying rats and has some decided advantages in some cases over others but a proper exercise of caution is required in carrying it out in order to ward off accidents. The principal poisons used in preparing the baits are strychnine, plaster of Paris, barium carbonate, arsenic and Paris green, potassium cyanide and phosphorus.

The preparation of these baits is indicated thus :—

1. *Strychnine.*—About one oz. of strychnine sulphate is dissolved in 1½ oz. of warm water and this is mixed with a thick syrup of jaggery, made with two seers of jaggery and half a seer of water. The mixture is heated and is sifted gradually over fifteen seers of grain. After twenty-four hours one oz. of the bait untouched by hand, is put into every rat hole, as the rats are said to have a ready perception of the smell of the human hand, any taint of which causes them to leave the bait severely alone.

2. *Plaster of Paris* (1 lb.) is substituted for strychnine.

3. *Barium carbonate* may be substituted for plaster of Paris.

Another poison bait easily prepared is by mixing Paris green with cooked rice. A bait that is commonly tried in Malabar against *Rattus rattus wroughtoni* with great success is prepared in a simple

manner. Rice is boiled with onions with a little coconut oil for flavour. To this is added a little arsenic poison. Small balls of these, of course untouched by hand, are placed on crowns of coconut palms.

Fumigation.—This method to destroy rats in their burrows has been tried in several instances with good results. The success of this measure will largely depend on the nature of the burrow and the thoroughness with which the exit holes are traced and closed. It may be ineffective or useless where the burrows are very complicated or labyrinthine. Carbon bisulphide, calcium cyanide dust, sulphur arsenic fumes have all been used to asphyxiate the animals in their habitations. Before fumigating however all entrances to rat runs should be carefully spotted out and closed with earth. In applying carbon bisulphide the method adopted is to saturate some cotton wool or other absorbent material such as a piece of sponge or handful of rags with the liquid and introduce the same into the rat burrows and finally close the opening with earth to prevent the gas escaping. Calcium cyanide may be used in a cyano-gas dusting machine by which the dust is pumped into the burrow. Sulphur arsenic fumes may be introduced by means of an ant exterminator.

Rat viruses.—In America several micro organisms or bacteria found originally in deceased rats have been exploited for destroying rats. Such rat viruses are reported to be largely advertised in that country. The results of trials with these have also been reported to be unsatisfactory. Even if they were successful the cost of the cultures would be prohibitive for general use.

Organized rat-hunts will certainly confer great benefit. Skilled and trained hands can effectively control rats by trapping. But in this more than in any other the need for organization and co-operation cannot be stressed too much so as to make the campaign effective and fruitful.

The encouragement of all natural enemies of rats is certainly one of the means of checking their increase.

It may be noted that in some cases the problem of their control may have to be tackled by a combination of some of these methods so as to yield beneficial results.

Conclusion.

In presenting this note, especially the latter portion regarding control, the writer had other objects in mind than merely giving a narrative of several measures tried but for want of greater opportunities for actually testing these in the field the portion dealing with this aspect is necessarily unsatisfactory. It is also felt that there is much room for further studies of the habits and habitations of these animals on which the entire question of control mainly hinges. In spite of all these defects the writer ventures to hope that this paper will have achieved more than what it set out to do if it, in the least manner, leads to greater familiarity with or increased interest in these unattractive but very important animal pests.